

## NOTES ON EUROPEAN FOSSIL HORSES

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The problem of European fossil horses has always attracted the attention of zoölogists. Since the times of Cuvier, the subject has been treated by H. v. Meyer, Pomel, Rüttimeyer, Owen, Major, Nehring, Woldrich, and many others and a great number of forms have been described, until, in 1886, Lydekker<sup>1</sup> provisionally grouped them under two headings: *Equus caballus* Linnæus, and *Equus stenonis* Cocchi. Thus matters stood when, in 1899, Boule,<sup>2</sup> in a most suggestive paper, pointed out that, in addition to these, a third species, *Equus robustus* Pomel, could be distinguished, which although approaching the *caballus* type, was, he thought, more nearly related to *stenonis*.

Since 1904 Professor Ewart<sup>3</sup> of Edinburgh has taken up the subject with a view to elucidating the origin of domestic horses. According to his theory<sup>4</sup> three types of domestic (and ancestral wild) horses can be distinguished; a "Plateau" variety including the Celtic pony and the Arab, which can be traced back to the Pliocene *Equus sivalensis*,<sup>5</sup> a "Forest" variety typified by the heavy draught horses of continental Europe and descended from Pomel's *Equus robustus*, and a "Steppe" variety still found in a wild state in Mongolia, *Equus przewalskii*, which has influenced some of the races of European cart-horses. Some more recent papers by Soergel,<sup>6</sup> Antonius,<sup>7</sup> and Boule<sup>8</sup> may be mentioned here; and finally an elaborate paper by v. Reichenau,<sup>9</sup> in which a number of new species and two new genera are described, which however has more confused than cleared the subject.

<sup>1</sup> Cat. Foss. Mamm. B. M., III, pp. 69-71, 73-88, (1886).

<sup>2</sup> Bull. Soc. Géol. France, (3) XXVII, pp. 531-42, text fig. 1-22, [1899] (March 1900).

<sup>3</sup> The most important of these papers are the following: Trans. Highl. Agric. Soc. Scotland, (5) XVI, pp. 230-268 (1904); Trans. Roy. Soc. Edinburgh, XLV, pp. 555-587 (1907); Science, (N.S.) XXX, pp. 219-223 (1909). Although I am compelled to state that his results are entirely wrong, yet I gladly admit that I owe many valuable suggestions to his papers.

<sup>4</sup> Similar views are held by Doctor Duerst (Carnegie Inst. Publ., no. 73, vol. 2, pp. 339-446; 1908).

<sup>5</sup> Or a nearly allied type which is called *Equus agilis* Ewart.

<sup>6</sup> Neues Jahrb. Min., Beilagebd. XXXII, pp. 740-761 (1911).

<sup>7</sup> Verh. k. k. zool. bot. Ges., LXII, pp. (64)-(78) (1912).

<sup>8</sup> Ann. Paléontol., V, pp. 113-135 (1910).

<sup>9</sup> Abh. Geol. Landesanst. Darmstadt, VII, pp. 1-155 (1915).

The evidence afforded by fossil bones and teeth found in Europe, Asia, and Africa appears to admit only two general types. In the species named *stenonis*, *atlanticus*, *persicus*, etc., the anterior pillar (protocone) of the premolars and molars is short (generally only one third of the total length of the tooth) with the anterior lobe scarcely developed and the interior margin mostly convex, straight or only slightly bent in at the middle. The enamel folds are moderately developed, the paracone and metacone are thick and their lateral surface convex, and the parastyle and mesostyle narrow and, if at all, only doubled in the anterior premolars. The eye sockets are somewhat projecting, and the angle of the lower jaw is deep. In the limbs the lower portions (radius-metacarpal and tibia-metatarsal) are comparatively long and narrow, the upper portions (humerus, femur) shorter than in the next species.<sup>10</sup>

In the other type to which such names as *caballus*, *phicidens*, *robustus*, *süssenbornensis*, *mosbachensis*, *przewalskii*, etc., have been applied, the anterior pillar of the cheek teeth is generally longer (usually more than one third of the total length of the tooth) with the posterior lobe always and the anterior one in many cases of considerable size, the interior margin being always bent in or even sharply divided at the middle. The enamel folds are more pronounced, the paracone and metacone distinctly lunate and their outer border concave, and the parastyle and mesostyle more imposing and doubled in most of the cheek teeth; the eye sockets are not projecting and the angle of the lower jaw is much less deep. The metatarsals and metacarpals are as a rule comparatively shorter and broader in specimens from older strata but about as slender as in the former species in more recent ones. The upper portions of the limbs (humerus, femur) are, however, somewhat longer compared to the lower portions (tibia, metatarsus, etc.).

It has hitherto been supposed that *Equus sivalensis* belongs to the first or *stenonis* type. But a renewed examination of Mr. Lydekker's beautiful plates<sup>11</sup> makes me believe that it is a member of the *caballus* series. The shape of the protocone, paracone and metacone and of the para- and mesostyle are decidedly of this type. This is still more so in *Equus namadicus* which is probably the direct descendant of *E. sivalensis* and apparently similar in the Ceylon tooth described by

<sup>10</sup> Lydekker, Guide to the specimens of the Horse family, p. 26 (1907).

<sup>11</sup> Mem. Geol. Surv. India (Palaentologia Indica), (10) II, pl. XIV, XV (1882).

Wayland<sup>12</sup> as *Equus zeylanicus* and in *Equus leptostylus* Matsumoto<sup>13</sup> from Honan, China. Lydekker has made a strong case of the presence in *E. sivalensis*, *E. stenonis* and the Arab of a preorbital depression; but since the same character is found in the southern but not in the northern local races of *E. quagga*, I cannot regard it as of specific value.

It has frequently been maintained that the horses of the second (*caballus-robustus*) type were derived from those of the *stenonis* group, chiefly on the assumption (1) that *stenonis* is older (Pliocene) (2) that in some of the older specimens of "*robustus*" only a rather small protocone is found in the cheekteeth. This is disproved however by a tooth from the Red Crag of Bawdsey, Suffolk,<sup>14</sup> contemporaneous with or even older than *stenonis* and distinguishable, except in size, from the most recent teeth of *E. caballus* only in details discussed below. I am not quite satisfied whether the remains usually referred to *E. stenonis* and *robustus* respectively from the Oreston Cave near Plymouth, from Kent's Hole near Torquay, from the lower deposits at Mosbach near Wiesbaden, and from the older Auvergne strata are all found in the same horizon, but this is of little importance since the Bawdsey tooth<sup>15</sup> is older than either of them. There is no doubt, therefore, that both species occurred together in Europe during upper Pliocene and probably also basal Pleistocene times.

I shall now designate the first of these types as *Equus stenonis*. The names *atlanticus*, *tigeris*, *mauretanicus*, *persicus*<sup>16</sup> and *stenonis* decidedly belong to this species and may be races of it; their exact value and relation among each other I am not at present prepared to state. Remains of Pliocene age have been found at Maragha in northern Persia, in the Val d'Arno, Italy, at various localities in France, southern Germany, Austria-Hungary, and southern England; some, as those of Mosbach or the Norfolk Forest Beds as well as some of the British caverns, are early Pleistocene; the most recent materials appear to be those from northern Africa which have been described

<sup>12</sup> Spolia Zeylan., X, pp. 261-280 (1916); the tooth of *E. caballus* figured for comparison obviously belongs to an Indian domestic horse and is of the Arab or *stenonis* type.

<sup>13</sup> Science Reports of the Tôhoku Imperial University, Sendai, 2nd ser. (Geology), III, no. 1, pp. 29-30 (not seen in the original; figure copied by Wayland).

<sup>14</sup> Owen, Quart. Journ. Geol. Soc., XII, p. 223, fig. 12 (p. 233) (1856).

<sup>15</sup> The exact age of these strata is probably upper Pliocene.

<sup>16</sup> Wilckens, Anz. Ak. Wien, XXIV, p. 43 (1887), and Nov. Act. Leop., LII, p. 268, pls. XI, figs. 18, 19, X, figs. 21-24, XIII, figs. 43-46, XIV, figs. 47 (1887); from the lower or middle Pliocene of Maragha, Persia.

by Pomel, Ph. Thomas, Boule, and other French authors, and are in part from late Pleistocene deposits. There is, however, no doubt that everything found in continental Europe and especially in England is not more recent than early Pleistocene, about corresponding to the "first Interglacial" of Penck.

The modern Arab thoroughbred shows all the main characters of this type which have been pointed out above; in addition it possesses only five lumbar vertebræ, a feature not hitherto corroborated in fossil material, the available skeletons being of a very fragmentary nature. But there is ample reason to believe from the facts known that it is from this type that the Arab, Barb, and the high-bred "Oriental" races have been developed. Since it has been shown that *E. sivalensis* is distinct it becomes highly probable that the thoroughbred races have been bred from the North African race of *Equus stenonis* which in a wild state survived up to the human period.

The second type, which should be known as *Equus caballus*<sup>17</sup> (including a very great number of names the exact status of which is not yet determinable), first appears in the Pliocene Red Crag of England and the upper (upper Pliocene) deposits of the Sivalik Hills and is still found in a wild state in Mongolia. From the oldest to more recent forms a gradual decrease in size seems to exist which leads from the large tooth from the Red Crag figured by Owen as *E. plicidens* and the coarse limb bones mentioned by Lydekker<sup>18</sup> as belonging to a very large species, to the small light-limbed horses of late palæolithic and neolithic times and Przewalski's horse of Mongolia. It would appear that this evolution has not taken place in a continuous series in at least those parts of western Europe which underwent glaciation, had their fauna destroyed by the ice and only in "interglacial" and post-glacial times regenerated from districts where it had been preserved. This assumption would explain the gaps between the large preglacial *E. c. plicidens*, the middle sized second stage (*E. c. robustus*) and the small third stage of the *E. c. spelæus-przewalskii* type. At present only in one case<sup>19</sup> have transitional stages been described, and these

<sup>17</sup> Fixed by Ewart (Trans. Highl. Agric. Soc. Scotland, (5) XVI, p. 264, on the Norwegian "Fjordhest." I cannot agree with Stejneger (Smith. Misc. Coll., XLVIII, p. 470; 1907) that Fitzinger (Ab. Ak. Wien, XXXI, pp. 139-212; 1858, XXXII, pp. 391-420; 1858, XXXV, pp. 335-36; 1859) should be regarded as first reviser, as he mixes up both types under his *E. caballus*.

<sup>18</sup> Cat. Foss. Mamm. B. M., III, p. 89 (1886); from the Norwich Crag.

<sup>19</sup> Soergel, l.c.; from Steinheim a.d. Murv, Württemberg.

are from an area which has remained free from ice during the whole Pleistocene. This gradual evolution may be observed in another important character; in the older forms the protocone of the cheek teeth is somewhat detached from the main body of the tooth and becomes more adpressed in more recent ones; the anterior lobe of the protocone is on the whole rather long and has been described as very characteristic of *E. c. przewalskii* by Lydekker;<sup>20</sup> it appears to be constantly so in the living and the more recent fossil forms, but in teeth which have been described from the lower Pleistocene of central Europe it is sometimes much smaller than the posterior lobe (from which it is generally clearly separated), though this is far from being constant, even in teeth from the same locality. The oldest tooth known (Bawdsey) is almost indistinguishable in this particular character from the most recent types.

It is this type, with a rather heavy head and six lumbar vertebræ, that has transmitted its principal characters to modern heavy races such as the "Pinzgauer" and "Belgian" draught horses. Their far superior size compared to that of the wild "tarpan" is most certainly the product of conscious breeding for certain purposes which has taken place in historical times and even within a rather short period. It has frequently been supposed that the most heavy types are derived from the middle sized horse of the "*robustus*" type, but this is impossible as that form had long ceased to exist at the time when horses were first domesticated. On the contrary all the available evidence afforded by fossil and prehistoric remains points to the fact that the most ancient domestic horses were of a type closely resembling the wild tarpan of Mongolia in their rather light build and somewhat clumsy head.

Professor Ewart believed that the "Celtic" pony is of another type than the tarpan. It has been already shown by Lydekker<sup>21</sup> that the skull characters adduced by him are not very reliable, and it has also been shown above that slender limbs are found in *E. stenorhis* as well as in the more recent forms of the *caballus* type. It would further appear probable that the presence of only five lumbar vertebræ in some of the skeletons examined by Professor Ewart is due to infusion of southern blood;<sup>22</sup> I have ascertained<sup>23</sup> that the Lofoten pony preserved in the Bergen Museum and regarded as of pure Celtic origin

<sup>20</sup> Guide to the specimens of the Horse family, p. 14, fig. 16A (1907).

<sup>21</sup> "Guide," p. 15.

<sup>22</sup> Ridgeway, The Origin and Influence of the Thoroughbred Horse, pp. 419-420 (1905); and Lydekker, The Horse and its relatives, p. 121 (1912).

<sup>23</sup> With the kind help of Professor Brinkmann.

both by him and all those who have examined it, has six lumbar vertebrae. I should think that the original "Celtic" pony was of "northern" blood, and that the "southern" characters presented by a number of the present ponies are entirely due to mixture with horses imported from the Mediterranean region within historic times.

The remarkable fact that in Europe alone both species of horse were found together, will be understood by the following zoögeographical deductions. In the later Tertiary, Europe had a land connection with North Africa as well as western Asia, immigration being possible both from the East and South. Thus *Equus stenonis* reached Europe from northern Africa as a representative of the western or Mediterranean, *Equus caballus* from central Asia with the eastern or Asiatic component of the Pliocene steppe fauna. During the Glacial Period the greater part of both faunae disappeared from central Europe. But when the ice had made its retreat, the Mediterranean landbridge was no longer in existence, and reimmigration was possible only from the East. In postglacial times *Equus caballus* ranged again all over northern and central Asia and the greater part of Europe and has given rise, through its various geographical subspecies, to the primitive domestic races of Russia and Asia and the heavy draught horses of western Europe. *Equus stenonis*, however, was held back in northern Africa where it has become the ancestor of the thoroughbred stock of Barbs and Arabs.<sup>24</sup>

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<sup>24</sup> It is interesting to note here that a tooth from Wadi Halfa, Nubia, described by Lydekker (Quart. Journ. Geol. Soc., XLIII, pp. 161-63; (1887), as nearly related to *E. sivalensis*, appears to me quite different. If conclusions may be drawn from a single specimen, it seems to approach *E. quagga* more than anything else.